

USER MANUAL

Accessory 70P

Tamagawa Encoder Interface Board

300-603732-xUxx

April 15, 2004



DELTA TAU
Data Systems, Inc.

NEW IDEAS IN MOTION ...

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INTRODUCTION

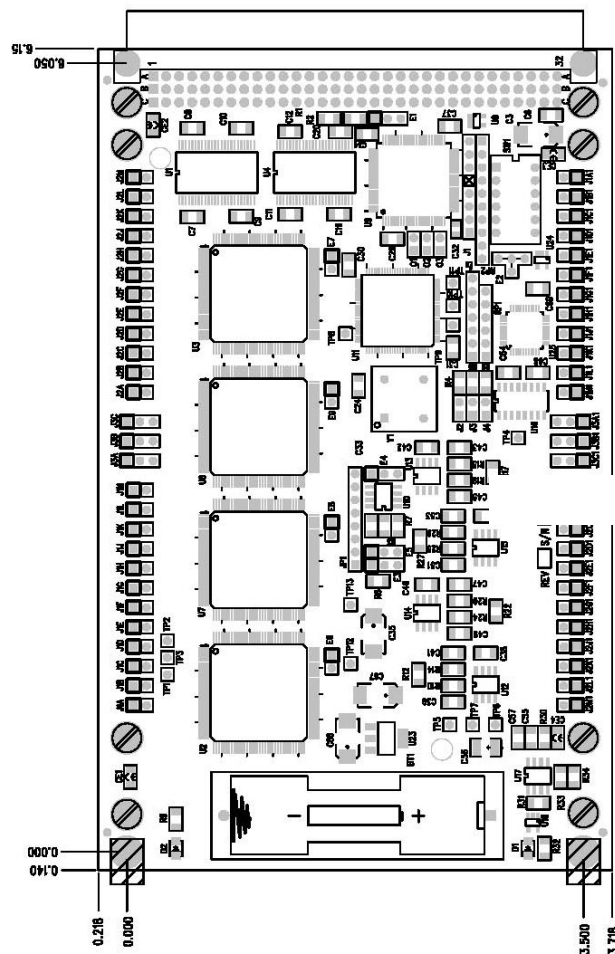
The Tamagawa interface card Acc-70P is a UMAC accessory that connects to PMAC via the JEXP port. The card is designed to handle two or four channels (add Option1).

The Tamagawa interface protocol is a 2.5Mbps RS485 multi-drop style protocol that is designed to receive data serially from an encoder device. It supports encoders that return 17 bits of position data, 16 bits of multi-turn data and 8 bits of alarm data when Data ID3 data code is requested.

This interface accessory card operates with FA-CODER TS5667N420-SA48 and FA-CODER TS5667N120-SA35.

Addressability of the Acc-70P Tamagawa interface allows up to 16 cards (24 encoder channels) to be daisy-chained with the JEXP port.

Layout



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ACC-70P SETUP

PMAC – Tamagawa Encoder Data Address Select

Set up the address select dip switch S1.

PMAC Chip Select Used	Encoder Data Address	Dip Switch SW1 Position					
		6	5	4	3	2	1
CS4	Y:\$FFD0-7	*	*	Closed	Closed	Open	Closed
CS6	Y:\$FFD8-F	*	*	Closed	Closed	Open	Open
CS10	Y:\$FFE0-7	*	*	Closed	Open	Closed	Closed
CS12	Y:\$FFE8-F	*	*	Closed	Open	Closed	Open
CS14	Y:\$FFF0-7	*	*	Closed	Open	Open	Closed
CS16	Y:\$FFF8-F	*	*	Closed	Open	Open	Open
* Can be either Closed or Open. The default setting is 2, 5, 6 Open and 1, 3, 4 Closed position (CS4).							

Offset Register Mapping Definitions

Address		X –Memory	Y-Memory
Base + 00h	1 st Channel		Single turn data and alarms
Base + 01h			Multi turn data and alarms
Base + 02h	2 nd Channel		Single turn data and alarms
Base + 03h			Multi turn data and alarms
Base + 04h	3 rd Channel		Single turn data and alarms
Base + 05h			Multi turn data and alarms
Base + 06h	4 th Channel		Single turn data and alarms
Base + 07h			Multi turn data and alarms

Turbo PMAC – Tamagawa Encoder Data Address Select

Set up the address select dip switch S1.

Turbo PMAC Chip Select Used	Encoder Data Address	Dip Switch SW1 Position					
		6	5	4	3	2	1
CS4	Y:\$78A00-07	Open	Open	Closed	Closed	Open	Closed
CS6	Y:\$78B00-07	Open	Open	Closed	Closed	Open	Open
CS10	Y:\$78C00-07	Open	Open	Closed	Open	Closed	Closed
CS12	Y:\$78D00-07	Open	Open	Closed	Open	Closed	Open
CS14	Y:\$78E00-07	Open	Open	Closed	Open	Open	Closed
CS16	Y:\$78F00-07	Open	Open	Closed	Open	Open	Open
The default setting is 2, 5, 6 Open and 1, 3, 4 Closed position (CS4).							

Offset Register Mapping Definitions

Address		X –Memory	Y-Memory
Base + 00h	1 st Channel		Single turn data & alarms
Base + 01h			Multi turn data & alarms
Base + 02h	2 nd Channel		Single turn data & alarms
Base + 03h			Multi turn data & alarms
Base + 04h	3 rd Channel		Single turn data & alarms
Base + 05h			Multi turn data & alarms
Base + 06h	4 th Channel		Single turn data & alarms
Base + 07h			Multi turn data & alarms

ENCODER CONVERSION TABLE SETUP

PMAC Encoder Conversion Table Setup

Use the previous table and SW1 to select the address. Once the address is selected via the SW1, the corresponding address is used to read the encoder position data.

Example: For PMAC: SW1-2, SW1-5 and SW1-6 are Open positions and the encoder conversion table entry will be:

Set: WY:\$720,\$20FFD0,\$1FFFF

Note:

This is a two-line input for one encoder channel. Make sure the related I-Variable (Ix03, Ix04) is pointed to the address of the second line. For example, for the above set up I103 and I104 should be = \$721.

Turbo PMAC Encoder Conversion Table Setup

Use the previous table and SW1 to select the address. Once the address is selected via the SW1, the corresponding address is used to read the encoder position data.

Example: For Turbo PMAC: SW1-2, SW1-5 and SW1-6 are Open positions and the rest are Closed positions, the encoder conversion table entry will be:

Set: I8000 = \$678C00 ; Y:\$3501
 I8001 = \$11000 ; Y:\$3502

Note:

This is a two-line input for one encoder channel. Make sure the related I-Variable (Ix03, Ix04) is pointed to the address of the second line. For example, for the above set up I103 and I104 should be = \$3502.

Combine Single Turn and Multi Turn Data

Tamagawa absolute encoder has two types of data – single-turn and multi-turn.

A PMAC PLC program is used to combine the data and then copy it to an actual position register.

Warning:

If the actual position is changed while the motors are enabled, a runaway condition may occur which can cause machine damage or bodily injury.

When changing the actual position register using a PLC program, make sure that the motors are not enabled.

Sample PMAC PLC Program for Initialize Position

```
M138->X:$3D,18,1                   ;#1 Open loop mode bit
M162->D:$2B                         ;#1 Actual position(1/[Ix08*32])
M110->Y:$FFD0,0,20,U               ;ENC1 Single turn data
M111->Y:$FFD1,0,16,S               ;ENC1 Multi turn data
M238->X:$79,18,1                   ;#2 Open loop mode bit
M262->D:$67                         ;#2 Actual position(1/[Ix08*32])
M210->Y:$FFD2,0,20,U               ;ENC2 Single turn data
M211->Y:$FFD3,0,16,S               ;ENC2 Multi turn data
```

```
OPEN PLC2 CLEAR           ;POS initialize PLC
IF(M138=1 AND M238=1)     ;Make sure if motor is open loop
P162=(M111 & $1FFFF)*131072 ;Convert Multi turn data for to cts for ENC1
P262=(M211 & $1FFFF)*131072 ;Convert Multi turn data for to cts for ENC2
M162=(P162+M110)*(I108*32) ;Combine Multi turn and single turn for ENC1
M262=(P262+M210)*(I208*32) ;Combine Multi turn and single turn for ENC2
DIS PLC2                  ;Disable PLC
ENDIF
CLOSE
```

Sample Turbo PMAC PLC Program for Initialize Position

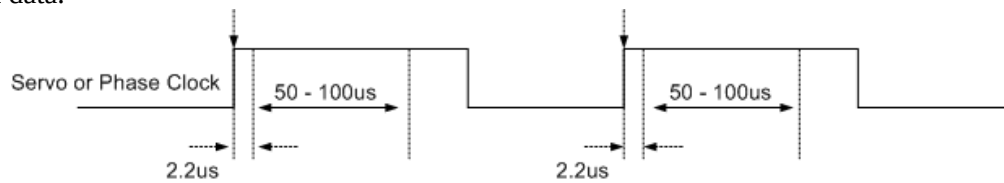
```
M138->X:$B0,18,1          ;#1 Open loop mode bit
M162->D:$8B                ;#1 Actual position(1/[Ixx08*32])
M110->Y:$78C00,0,20,U      ;ENC1 Single turn data
M111->Y:$78C01,0,16,S      ;ENC1 Multi turn data
M238->X:$130,18,1          ;#2 Open loop mode bit
M262->D:$10B               ;#2 Actual position(1/[Ixx08*32])
M210->Y:$78C02,0,20,U      ;ENC2 Single turn data
M211->Y:$78C03,0,16,S      ;ENC2 Multi turn data
OPEN PLC2 CLEAR           ;POS initialize PLC
IF(M138=1 AND M238=1)     ;Make sure if motor is open loop
P162=(M111 & $1FFFF)*131072 ;Convert Multi turn data for to cts for ENC1
P262=(M211 & $1FFFF)*131072 ;Convert Multi turn data for to cts for ENC2
M162=(P162+M110)*(I108*32) ;Combine Multi turn and single turn for ENC1
M262=(P262+M210)*(I208*32) ;Combine Multi turn and single turn for ENC2
DIS PLC2                  ;Disable PLC
ENDIF
CLOSE
```

SERVO/PHASE CLOCK SELECTION

Jumper E2 selects the servo or phase clock as the encoder request clock signal. With I-Variable setup such as I7m00, I7m01 and I7m02, clock frequency can be adjusted. Default servo clock frequency is 2.25kHz(442 us) and default phase clock frequency is 9.0kHz (110us). Refer to the PMAC/PMAC2 Software Reference or Turbo PMAC Software Reference manuals on how to set up the servo or phase clock.

Acc-70P is responsible for requesting and converting data from the encoder and the process is synchronized with either the servo or the phase clock. The rising edge of the clock will trigger the start of the request. The whole process takes approximately 50us to 100us. Therefore, the positive pulse width of the clock must be set to greater than or equal to 100us in order to guarantee completion.

If the positive pulse width is less than the process time for the Tamagawa encoder, it will send previously requested data.



Within 2.2us after the rising edge, Acc-70P will fetch alarm data from the previous conversion and command the encoder to return position data. It takes 50us - 100us for the encoder to return the new position data.

LEDs

Power Good LED-D2 Green

The interface board needs 5V power through TB1 or a PCI bus. When the voltage drops below 4.75V, the power good LED will be turned off.

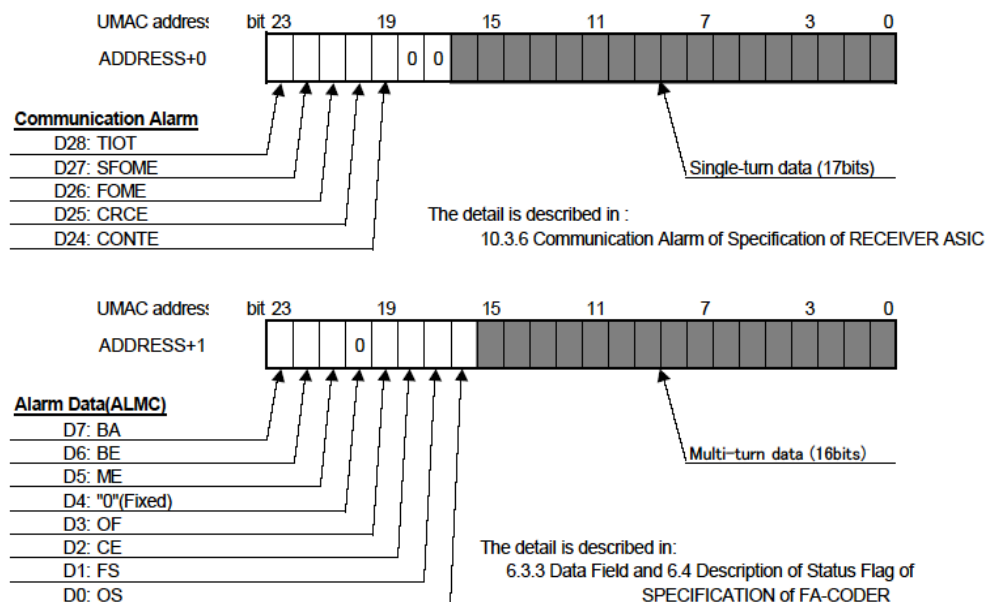
Battery Warning LED-D3 Red

The interface board provides battery back up for the encoder. In addition, it has a battery voltage monitor circuitry that serves as a battery low warning. When the battery voltage drops 5% below 3.6V, the red LED will activate.

Alarm Code

There are bit patterns of alarm code interpreted by the interface card. The following drawing shows the format of those bits.

ALMC bits are data that is returned from encoder register DF7 when DATA ID3 is requested.



Sample PMAC PLC for Alarm

```
M112->Y:$FFD0,16,8,U      ;ENC1 ERR1
M113->Y:$FFD1,16,8,U      ;ENC1 ERR2
M53->X:$0700,0,24,S       ;Timer
```

```
OPEN PLC3 CLEAR
P111=M113*$100+M112
IF(M113&$1=$1)
    SENDS"ALARM D0 OS"
ENDIF
IF(M113&$2=$2)
    SENDS"ALARM D1 FS"
ENDIF
IF(M113&$4=$4)
    SENDS"ALARM D2 CE"
ENDIF
IF(M113&$8=$8)
    SENDS"ALARM D3 OF"
ENDIF
IF(M113&$20=$20)
    SENDS"ALARM D5 ME"
ENDIF
IF(M113&$40=$40)
    SENDS"ALARM D6 BE"
ENDIF
IF(M113&$80=$80)
    SENDS"ALARM D7 BA"
ENDIF
IF(M112&$8=$8)
    SENDS"ALARM D24 CONTE"
ENDIF
```

```
IF(M112&$10=$10)
    SENDS"ALARM D25 CRCE"
ENDIF
IF(M112&$20=$20)
    SENDS"ALARM D26 FOME"
ENDIF
IF(M112&$40=$40)
    SENDS"ALARM D27 SFOME"
ENDIF
IF(M112&$80=$80)
    SENDS"ALARM D28 TIOT"
ENDIF
M53=10000*8388608/I10
WHILE(M53>0)
ENDW
CLOSE
```

Sample Turbo PMAC PLC for Alarm

```
M112->Y:$78C00,16,8,U    ;ENC1 ERR1
M113->Y:$78C01,16,8,U    ;ENC1 ERR2

OPEN PLC3 CLEAR
P111=M113*$100+M112
IF(M113&$1=$1)
    SENDS"ALARM D0 OS"
ENDIF
IF(M113&$2=$2)
    SENDS"ALARM D1 FS"
ENDIF
IF(M113&$4=$4)
    SENDS"ALARM D2 CE"
ENDIF
IF(M113&$8=$8)
    SENDS"ALARM D3 OF"
ENDIF
IF(M113&$20=$20)
    SENDS"ALARM D5 ME"
ENDIF
IF(M113&$40=$40)
    SENDS"ALARM D6 BE"
ENDIF
IF(M113&$80=$80)
    SENDS"ALARM D7 BA"
ENDIF
IF(M112&$8=$8)
    SENDS"ALARM D24 CONTE"
ENDIF
IF(M112&$10=$10)
    SENDS"ALARM D25 CRCE"
ENDIF
IF(M112&$20=$20)
    SENDS"ALARM D26 FOME"
ENDIF
IF(M112&$40=$40)
    SENDS"ALARM D27 SFOME"
ENDIF
IF(M112&$80=$80)
```

```
        SENDS"ALARM D28 TIOT"  
ENDIF  
I5311=10000*8388608/I10  
WHILE( I5311>0)  
ENDW  
CLOSE
```

RESET ENCODER'S ABSOLUTE POSITION REGISTERS

The absolute and multi-turn data position registers can be reset to zero. When resetting the single-turn register to zero, only the MSB 11 bits will be cleared. The remaining six LSB bits are not cleared.

When resetting the absolute position registers in the encoder, reset the single-turn data before resetting the multi-turn data.

To reset absolute position, write 00 to the base address 12 times for the single-turn reset. To reset the multi-turn data register, write 00 to the base address +1 (also 12 times).

Sample PMAC PLC

```
Y:$FFD0      ; Channel #1 single turn data with SW1 default setting.
Y:$FFD1      ; Channel #1 multi turn data with SW1 default setting.
Y:$FFD2      ; Channel #2 single turn data with SW1 default setting.
Y:$FFD3      ; Channel #2 multi turn data with SW1 default setting.
Y:$FFD4      ; Channel #3 single turn data with SW1 default setting.
Y:$FFD5      ; Channel #3 multi turn data with SW1 default setting.
Y:$FFD6      ; Channel #4 single turn data with SW1 default setting.
Y:$FFD7      ; Channel #4 multi turn data with SW1 default setting.

OPEN PLC1 CLEAR
  WHILE(P501<12)      ;Execute reset sequence 12 times
    CMD"WY:$FFD0,0"    ;Zero reset channel #1 single turn data
    P501=P501+1
  ENDW
  P501=0
  M51=20*8388608/I10    ;20msec timer (M51->X:$0700,0,24,S)
  WHILE(M51>0)
  ENDW
  WHILE(P501<12)
    CMD"WY:$FFD1,0"    ;Zero reset channel #1 multi turn data
    P501=P501+1
  ENDW
  P501=0
  DIS PLC1
CLOSE
```

Sample Turbo PMAC PLC

```
Y:$78A00     ; Channel #1 single turn data with SW1 default setting.
Y:$78A01     ; Channel #1 multi turn data with SW1 default setting.
Y:$78A02     ; Channel #2 single turn data with SW1 default setting.
Y:$78A03     ; Channel #2 multi turn data with SW1 default setting.
Y:$78A04     ; Channel #3 single turn data with SW1 default setting.
Y:$78A05     ; Channel #3 multi turn data with SW1 default setting.
Y:$78A06     ; Channel #4 single turn data with SW1 default setting.
Y:$78A07     ; Channel #4 multi turn data with SW1 default setting.

OPEN PLC1 CLEAR
  WHILE(P501<12)      ;Execute reset sequence 12 times
    CMD"WY:$78A08,0"   ;Zero reset channel#1 single turn data
    P501=P501+1
  ENDW

  P501=0
  I5111=20*8388608/I10 ;20msec timer
  WHILE(I5111>0)
  ENDW
```

```
    WHILE(P501<12)
        CMD"WY:$78A09,0"      ;Zero reset channel#1 multi turn data
        P501=P501+1
    ENDW
    P501=0
    DIS PLC1
CLOSE
```

JUMPER CONFIGURATIONS

E1 Factory Use

Position	Setting	Function
E1	1-2	Factory use (for future use)
	Off (default)	

E2 SYNC Clock Select

Position	Setting	Function
E2	1-2	Use phase clock as encoder request signal
	1-3 (default)	Use servo clock as encoder request signal
	1-4	Future use

E3-E5 FPGA Mode Select

Position	Setting	Function
E3, E4, E5	1-2	Factory test
	2-3 (default)	Normal operation

E6-E9 Request Signal Select

Position	Setting	Function
E6	On Default	Enable request signal for Channel 1
	Off	Disable request signal for Channel 1
E7	On Default	Enable request signal for Channel 2
	Off	Disable request signal for Channel 2
E8	On Default	Enable request signal for Channel 3
	Off	Disable request signal for Channel 3
E9	On Default	Enable request signal for Channel 4
	Off	Disable request signal for Channel 4

JP2-4 FPGA Mode Select

Position	Setting	Function
JP2, JP3, JP4	1-2	Factory test
	Off (default)	Normal operation

CONNECTOR PINOUTS

Connector J6 – Encoder 1			
Pin#	Symbol	Function	Description
1	GND	Reference	+5V and battery return
2	DATA +	Input	Encoder Data +
3	CLOCK -	Output	Encoder request signal clock out +
4	+5V	Output	
5	BATTERY +	Output	3.6V battery voltage out
6		N/A	
7	CASE GND	Chassis	
8	CASE GND	Chassis	
9	GND	Reference	+5V and battery return
10	DATA -	Input	Encoder data-
11	CLOCK +	Output	Encoder request signal clock out -
12	+5V	Output	
13		N/A	
14		N/A	
15	CASE GND	Chassis	

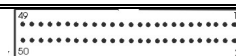
Connector J7 – Encoder 2			
Pin#	Symbol	Function	Description
2	DATA +	Input	Encoder data +
3	CLOCK -	Output	Encoder request signal clock out +
4	+5V	Output	
5	BATTERY +	Output	3.6V battery voltage out
6		N/A	
7	CASE GND	Chassis	
8	CASE GND	Chassis	
9	GND	Reference	+5V and battery return
10	DATA -	Input	Encoder data-
11	CLOCK +	Output	Encoder request signal clock out -
12	+5V	Output	
13		N/A	
14		N/A	
15	CASE GND	Chassis	

Connector J9 – Encoder 3

Pin#	Symbol	Function	Description
1	GND	Reference	+5V and battery return
2	DATA +	Input	Encoder data +
3	CLOCK -	Output	Encoder request signal clock out +
4	+5V	Output	
5	BATTERY +	Output	3.6V battery voltage out
6		N/A	
7	CASE GND	Chassis	
8	CASE GND	Chassis	
9	GND	Reference	+5V and battery return
10	DATA -	Input	Encoder data -
11	CLOCK +	Output	Encoder request signal clock out -
12	+5V	Output	
13		N/A	
14		N/A	
15	CASE GND	Chassis	

Connector J8 – Encoder 4

Pin#	Symbol	Function	Description
1	GND	Reference	+5V and battery return
2	DATA +	Input	Encoder data +
3	CLOCK -	Output	Encoder request signal clock out +
4	+5V	Output	
5	BATTERY +	Output	3.6V battery voltage out
6		N/A	
7	CASE GND	Chassis	
8	CASE GND	Chassis	
9	GND	Reference	+5V and battery return
10	DATA -	Input	Encoder data -
11	CLOCK +	Output	Encoder request signal clock out -
12	+5V	Output	
13		N/A	
14		N/A	
15	CASE GND	Chassis	

J1 JEXP (50- Pin Header)

Top View

Pin	Symbol	Function	Description
1	D0	Bidirectional	PMAC Data Bus Bit 0
2	D1	Bidirectional	PMAC Data Bus Bit 1
3	D2	Bidirectional	PMAC Data Bus Bit 2
4	D3	Bidirectional	PMAC Data Bus Bit 3
5	D4	Bidirectional	PMAC Data Bus Bit 4
6	D5	Bidirectional	PMAC Data Bus Bit 5
7	D6	Bidirectional	PMAC Data Bus Bit 6
8	D7	Bidirectional	PMAC Data Bus Bit 7
9	D8	Bidirectional	PMAC Data Bus Bit 8
10	D9	Bidirectional	PMAC Data Bus Bit 9
11	D10	Bidirectional	PMAC Data Bus Bit 10
12	D11	Bidirectional	PMAC Data Bus Bit 11

13	D12	Bidirectional	PMAC Data Bus Bit 12
14	D13	Bidirectional	PMAC Data Bus Bit 13
15	D14	Bidirectional	PMAC Data Bus Bit 14
16	D15	Bidirectional	PMAC Data Bus Bit 15
17	D16	Bidirectional	PMAC Data Bus Bit 16
18	D17	Bidirectional	PMAC Data Bus Bit 17
19	D18	Bidirectional	PMAC Data Bus Bit 18
20	D19	Bidirectional	PMAC Data Bus Bit 19
21	D20	Bidirectional	PMAC Data Bus Bit 20
22	D21	Bidirectional	PMAC Data Bus Bit 21
23	D22	Bidirectional	PMAC Data Bus Bit 22
24	D23	Bidirectional	PMAC Data Bus Bit 23
25	GND	Common	PMAC Common
26	GND	Common	PMAC Common
27	A0	Input	PMAC Address Bus Bit 0
28	A1	Input	PMAC Address Bus Bit 1
29	A2	Input	PMAC Address Bus Bit 2
30	A3	Input	PMAC Address Bus Bit 3
31	CS02/	Input	PMAC Chip Select
32	X/Y	Input	PMAC X/Y Select
33	CS2/	Input	PMAC Chip Select
34	CS3/	Input	PMAC Chip Select
35	CS04/	Input	PMAC Chip Select
36	CS06/	Input	PMAC Chip Select
37	CS10/	Input	PMAC Chip Select
38	CS11/	Input	PMAC Chip Select
39	CS12/	Input	PMAC Chip Select
40	CS13/	Input	PMAC Chip Select
41	CS14/	Input	PMAC Chip Select
42	CS16/	Input	PMAC Chip Select
43	WR/	Write Strobe	Write Strobe, Low True
44	RD/	Read Strobe	Read Strobe, Low True
45	GND	Common	PMAC Common
46	GND	Common	PMAC Common
47	RESET	Input	Internal Reset, High True
48	WT/	Output	CPU Wait
49	SER	Input	CPU Servo Clock
50	PHA	Input	CPU Phase Clock

TB1

Pin #	Signal Description	Note
1	-BATT	For external power supply
2	+BATT	For external power supply

SCHEMATICS

